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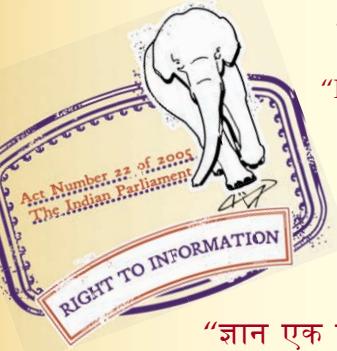
“Step Out From the Old to the New”

IS 10218 (1982): Method of determination of grindability index [MED 17: Chemical Engineering Plants and Related Equipment]

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“Knowledge is such a treasure which cannot be stolen”



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Indian Standard

METHOD OF DETERMINATION OF GRINDABILITY INDEX

1. Scope — Covers the method of determinations of grindability index for size reduction by shear.

2. Definition

2.1 Grindability — It is the resistance of a material to comminution. The absolute grindability cannot be measured. However, relative grindability can be measured either by direct or indirect measurement.

3. Applicability — In a large number of size reduction units the materials are ground by shear force applied between two surfaces. In such cases the strength of the material under shear is an important criteria.

4. Details of Equipment

- a) Standard Ball Mill as per IS : 4642-1968 'Specification for ball, pebble and tube mills'.
- b) Balls of standard sizes and weights
- c) Sieve shaker
- d) Standard sieves as per IS : 460 'Specification for test sieves'
- e) Balances — 2 (One analytical, one up to 2 000 g)
- f) Weight boxes — 2 (One analytical, one up to 2 000 g)
- g) Trays for sampling — 1 x 1 m
- h) Measuring cylinder

4.1 Ball Mill — The mill used shall be cylindrical in shape with smooth inside surface and with round corners as per IS : 4642-1968. The mill shall have the following dimensions (internal) :

Diameter	30.5 cm
Length	30.5 cm

4.1.1 The mill shall be provided with a mechanical revolution counter and shall be rotated at a constant speed of 70 rev/min.

4.1.2 The balls shall be of forged alloy steel with mirror finish.

4.1.3 The ball charge shall consist of 285 steel balls with total weight 20 125 g \pm 25 g. The size distribution of the ball charge shall be:

<i>Nominal Size (mm)</i>	<i>No. of Balls</i>	<i>Weight (g)</i>
38.0	43	8 730
31.5	67	7 197
25.0	10	705
19.0	71	2 085
12.5	94	1 441
	285	20 131

The weight and total number of balls shall be kept constant.

5. Procedure — About 25 kg of the representative sample shall be sufficient to carry out grindability test. The sample shall first be crushed to 6 mm in jaw crusher. The 6 mm crushed sample shall then be crushed through rolls and screened through 2.8 mm sieve. Crushing and sieving of the

oversize shall be continued until the whole sample passes through the 2.8 mm sieve. For taking samples from the 25 kg lot, standard sampling procedure like coning and quartering shall be used.

5.1 A screen analysis of minus 2.8 mm material shall be made using a sieve set in the range of 2.36 mm to 150 microns sieves.

5.2 The 80 percent passing size of test feed (F) shall be determined by plotting cumulative weight passing against size in microns.

5.3 700 ml of the 2.8 mm size sample shall be weighed and placed in the ball mill. To take 700 ml of the sample, the material 2.8 mm size shall be placed in a 1.000 ml measuring cylinder, 50 mm diameter, and compacted by shaking to yield a volume of 700 ml. The measuring cylinder shall be placed on a vibrating sieve shaker for 30 seconds.

5.4 The sample shall be ground for a known number of revolutions (N) say 100.

5.5 The ground sample shall be removed and screened through a specific sieve of P_1 microns.

5.6 The screen undersize shall be weighed from which the quantity finer than P_1 size, originally present in the test sample shall be deducted so as to get the net undersize produce due to grinding for N revolutions. From this the net weight grinded per revolution shall be calculated (G_{op}).

5.7 A second feed sample for the ball mill shall be prepared by mixing the screen oversize with a fresh test sample from the stock so as to get the total weight of the same as in 5.3.

5.8 The grinding and screening shall be repeated until a circulating load of 25 percent is achieved, which is equivalent to 28.6 percent of the mill discharge (finer than P_1 size) at equilibrium, under standard conditions and the amount of the net product finer than P_1 size produced due to grinding shall be determined. The average quantity of finer produce per revolution (G_{op}) shall be calculated from the last two or three grinds.

5.9 The final product obtained shall be screen analyzed from which the size in microns (P) through which 80 percent of the product passes shall be determined.

6. Calculation of Grindability Under Recirculating Load — The following equation shall be used for calculating grindability index G_i in Kwh/tonnes.

$$G_i = \frac{44.5 \times 1.1}{(P_1)^{0.23} \times (G_{op})^{0.82} \times \left[\frac{10}{\sqrt{P}} \cdot \frac{10}{\sqrt{F}} \right]}$$

where

P_1 = screen size in microns,

G_{op} = net weight grinded per revolution,

P = sieve size in microns through which 80 percent product passes, and

F = sieve size in micron through which 80 percent feed passes.

Note — As already mentioned, different sizes of sieves can be used in 5.5 (P_1). However, by using fine sieves, the sieving is inaccurate and takes long time. Normally 150 μ m size sieve shall serve the purpose but sieving has to be done twice.

EXPLANATORY NOTE

The grindability of a material is a measure of the ease with which it can be ground and as such it reflects some of the physical properties of the material like hardness, strength, tenacity and fracture.